AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the above-identified application:

1. (currently amended) A fault detection system for detecting faults in a turbine engine, the fault detection system comprising:

a sensor data processor, the sensor data processor configured to receive sensor data from the turbine engine and ~~augment the sensor data to provide an augmented data set, wherein the sensor data processor is configured to augment the sensor data by generating~~ generate residuals from the sensor data and determine ~~determining~~ a rate of change of the residuals, the residuals from the sensor data and the rate of change of the residuals providing an augmented data set; and

a fuzzy logic inference system, the fuzzy logic inference system configured to receive the augmented data set, and wherein the fuzzy logic inference system includes a plurality of membership functions and wherein each of the plurality of membership functions is associated with at least one data type in the residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~, and wherein the fuzzy logic system is configured to fuzzify the residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~ using the plurality of membership functions and analyze the residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~ to determine a likelihood that a fault has occurred in the turbine engine.

2. (withdrawn-currently amended) The system of claim 1 wherein the sensor data processor is further configured to determine ~~augment the sensor data by determining~~ a rate of change of the sensor data.

3. (cancelled).

4. (cancelled)

5. (currently amended) The system of claim 1 wherein the sensor data processor is further configured to ~~augment the sensor data by computing~~ compute a margin for the sensor data.

6. (previously presented) The system of claim 1 wherein the sensor data comprises engine speed data, fuel flow data and exhaust gas temperature data.

7. (currently amended) The system of claim 1 wherein the sensor data processor is configured to receive exhaust gas temperature data and wherein the sensor data processor is further configured to ~~augment the exhaust gas temperature data by determining~~ determine exhaust gas temperature margin data corresponding to a difference between the exhaust gas temperature data and a maximum safe temperature.

8. (cancelled)

9. (currently amended) The system of claim 1 wherein the fuzzy logic inference system includes a plurality of rules, and wherein the fuzzy logic system is configured to evaluate the fuzzified residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~ according to the plurality of rules.

10. (previously presented) The system of claim 9 wherein the fuzzy logic inference system is further configured to aggregate outputs of the plurality of rules and defuzzify the aggregated output for input into a diagnostic system.

11. (currently amended) The system of claim 10 ~~wherein the aircraft system comprises a turbine engine and~~ wherein the sensor data comprises exhaust gas temperature data, engine speed data, and fuel flow data, and wherein the sensor data processor is configured to ~~augment the sensor data by generating~~ generate residuals from the exhaust gas temperature data, engine speed data, and fuel flow data, and wherein the sensor data processor is configured to ~~further augment the sensor data by determining~~ determine a rate of change of the residuals from the exhaust gas temperature data, engine speed data, and fuel flow data, and wherein the sensor data processor is configured to ~~further augment the sensor data by determining~~ determine a margin for the exhaust gas temperature data corresponding to a difference between the exhaust gas temperature data and a maximum safe exhaust gas temperature for the turbine engine.

12. (cancelled)

13. (cancelled)

14. (cancelled) .

15. (cancelled)

16. (cancelled)

17. (cancelled)

18. (cancelled).

19. (cancelled).

20. (cancelled)

21. (withdrawn-currently amended) A program product comprising:

a) a fault detection program, the fault detection program including:

a sensor data processor, the sensor data processor configured to receive sensor data from the turbine engine and ~~augment the sensor data to provide an augmented data set, wherein the sensor data processor is configured to augment the sensor data by generating~~ generate residuals from the sensor data and determine ~~determining~~ a rate of change of the residuals, the residuals from the sensor data and the rate of change of the residuals providing an augmented data set; and

a fuzzy logic inference system, the fuzzy logic inference system configured to receive the augmented data set, and wherein the fuzzy logic inference system includes a plurality of membership functions and wherein each of the plurality of membership functions is associated with at least one data type in the residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~, and wherein the fuzzy logic system is configured to fuzzify the residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~ using the plurality of membership functions and analyze the residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~ to determine a likelihood that a fault has occurred in the turbine engine; and

b) computer-readable media bearing said fault detection program.

22. (cancelled)

23. (cancelled)

24. (cancelled)

25. (withdrawn) The program product of claim 21 wherein the sensor data comprises engine speed data, fuel flow data and exhaust gas temperature data

26. (withdrawn-currently amended) The program product of claim 21 wherein the sensor data processor is configured to receive exhaust gas temperature data and wherein the sensor data processor is further configured to ~~augment the exhaust gas temperature data by determining~~ determine exhaust gas temperature margin data corresponding to a difference between the exhaust gas temperature data and a maximum safe exhaust gas temperature for the turbine engine.

27. (cancelled)

28. (withdrawn-currently amended) The program product of claim 21 wherein the fuzzy logic inference system includes a plurality of rules, and wherein the fuzzy logic system is configured to evaluate the fuzzified residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~ according to the plurality of rules.

29. (withdrawn) The program product of claim 28 wherein the fuzzy logic inference system is further configured to aggregate outputs of the plurality of rules and defuzzify the aggregated output for input into a diagnostic system.

30. (withdrawn-currently amended) The program product of claim 21 wherein the sensor data comprises exhaust gas temperature data, engine speed data, and fuel flow data, and wherein the sensor data processor is configured to ~~augment the sensor data by generating~~ generate residuals from the exhaust gas temperature data, engine speed data, and fuel flow data, and wherein the sensor data processor is configured to ~~further augment the sensor data by determining~~ determine a rate of change of the residuals from the exhaust gas temperature data, engine speed data, and fuel flow data, and wherein the sensor data processor is configured to ~~further augment the sensor data by determining~~ determine a margin for the exhaust gas temperature data corresponding to a difference between the exhaust gas temperature data and a maximum safe exhaust gas temperature for the turbine engine.

31. (currently amended) An apparatus comprising:

a) a processor;

b) a memory coupled to the processor;

c) a fault detection program residing in memory and being executed by the processor, the fault detection program including:

i) a sensor data processing program, the sensor data processing program configured to receive sensor data from a turbine engine and ~~augment the sensor data to provide augmented data set, wherein the sensor data processing program is configured to augment the sensor data by generating~~ generate residuals from the sensor data and determine ~~determining~~ a rate of change of the residuals, the residuals from the sensor data and the rate of change of the residuals providing an augmented data set; and

ii) a fuzzy logic inference program, the fuzzy logic inference program configured to receive the augmented data set, and wherein the fuzzy logic inference program includes a plurality of membership functions and wherein each of the plurality of membership functions is associated with at least one data type in the residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~, and wherein the fuzzy logic program is configured to fuzzify the residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~ using the plurality of membership functions and analyze the residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~ to determine a likelihood that a fault has occurred.

32. (cancelled)

33. (original) The apparatus of claim 31 wherein the sensor data comprises engine speed data, fuel flow data and exhaust gas temperature data.

34. (currently amended) The apparatus of claim 31 wherein the sensor data processing program is configured to receive exhaust gas temperature data and wherein the sensor data processor is further configured to ~~augment the exhaust gas temperature data by determining~~ determine exhaust gas temperature margin data corresponding to a difference between the exhaust gas temperature data and a selected maximum safe exhaust gas temperature for the turbine engine.

35. (cancelled)

36. (currently amended) The apparatus of claim 31 wherein the fuzzy logic inference program includes a plurality of rules, and wherein the fuzzy logic system is configured to evaluate the fuzzified residuals from the sensor data and the rate of change of the residuals ~~augmented data set~~ according to the plurality of rules.

37. (previously presented) The apparatus of claim 36 wherein the fuzzy logic inference program is further configured to aggregate outputs of the plurality of rules and defuzzify the aggregated output for input into a diagnostic system.

38. (currently amended) The apparatus of claim 31 wherein the sensor data comprises exhaust gas temperature data, engine speed data, and fuel flow data, and wherein the sensor data processing program is configured to ~~augment the sensor data by generating~~ generate residuals from the exhaust gas temperature data, engine speed data, and fuel flow data, and wherein the sensor data processing program is configured to ~~further augment the sensor data by determining~~ determine a rate of change of the residuals from the exhaust gas temperature data, engine speed data, and fuel flow data, and wherein the sensor data processing program is configured to ~~further augment the sensor data by determining~~ determine a margin for the exhaust gas temperature data corresponding to a difference between the exhaust gas temperature data and a maximum safe exhaust gas temperature for the turbine engine.

39. (previously presented) A fault detection system for detecting faults in a turbine engine, the fault detection system comprising:

a sensor data processor, the sensor data processor configured to:

receive sensor data from the turbine engine, the sensor data including exhaust gas temperature data, engine speed data, and fuel flow data;

generate exhaust gas temperature residuals by comparing the exhaust gas temperature data to expected values of exhaust gas temperature;

generate engine speed residuals by comparing the engine speed data to expected values of engine speed;

generate fuel flow residuals by comparing the fuel flow data to expected values of fuel flow;

determine a rate of change of the exhaust gas temperature residuals;

determine a rate of change of the engine speed residuals;

determine a rate of change of the fuel flow residuals; and

a fuzzy logic inference system, the fuzzy logic inference system configured to receive the exhaust gas temperature residuals, the engine speed residuals, the fuel flow residuals, the rate of change of the exhaust gas temperature residuals, the rate of change of the engine speed residuals, and the rate of change of the fuel flow residuals, and wherein the fuzzy logic inference system includes a plurality of membership functions, and wherein the fuzzy logic system is configured to fuzzify the exhaust gas temperature residuals, the engine speed residuals, the fuel flow residuals, the rate of change of the exhaust gas temperature residuals, the rate of change of the engine speed residuals, and the rate of change of the fuel flow residuals using the plurality of membership functions to determine a likelihood that a fault has occurred in the turbine engine.

40. (previously presented) The system of claim 39 wherein the plurality of membership functions include a low membership function, a medium membership function, and a high membership function.

41. (previously presented) The system of claim 40 wherein the low membership function comprises a first sigmoid function, and wherein the medium membership function comprises a trapezoid function, and wherein the high membership function comprises a second sigmoid function.

42. (previously presented) The system of claim 40 wherein the fuzzy logic inference system is configured to fuzzify the exhaust gas temperature residuals, the engine speed residuals, the fuel flow residuals, the rate of change of the exhaust gas temperature residuals, the rate of change of the engine speed residuals, and the rate of change of the fuel flow residuals using the plurality of membership functions by generating an aggregated output function from the plurality of membership functions.

43. (previously presented) The system of claim 42 wherein the fuzzy logic inference system is configured to determine a likelihood that a fault has occurred in the turbine engine by determining a centroid of area under the aggregated output function.

44. (previously presented) The system of claim 43 wherein the fault comprises a high pressure spool fault.

45. (previously presented) The system of claim 39 wherein the sensor data processor is configured to determine the rate of change of the exhaust gas temperature residuals using a linear fit of the exhaust gas temperature residuals, and wherein the sensor data processor is configured to determine the rate of change of the engine speed residuals using a linear fit of the engine speed residuals, and wherein the sensor data processor is configured to determine the rate of change of the fuel flow residuals using a linear fit of the fuel flow residuals.